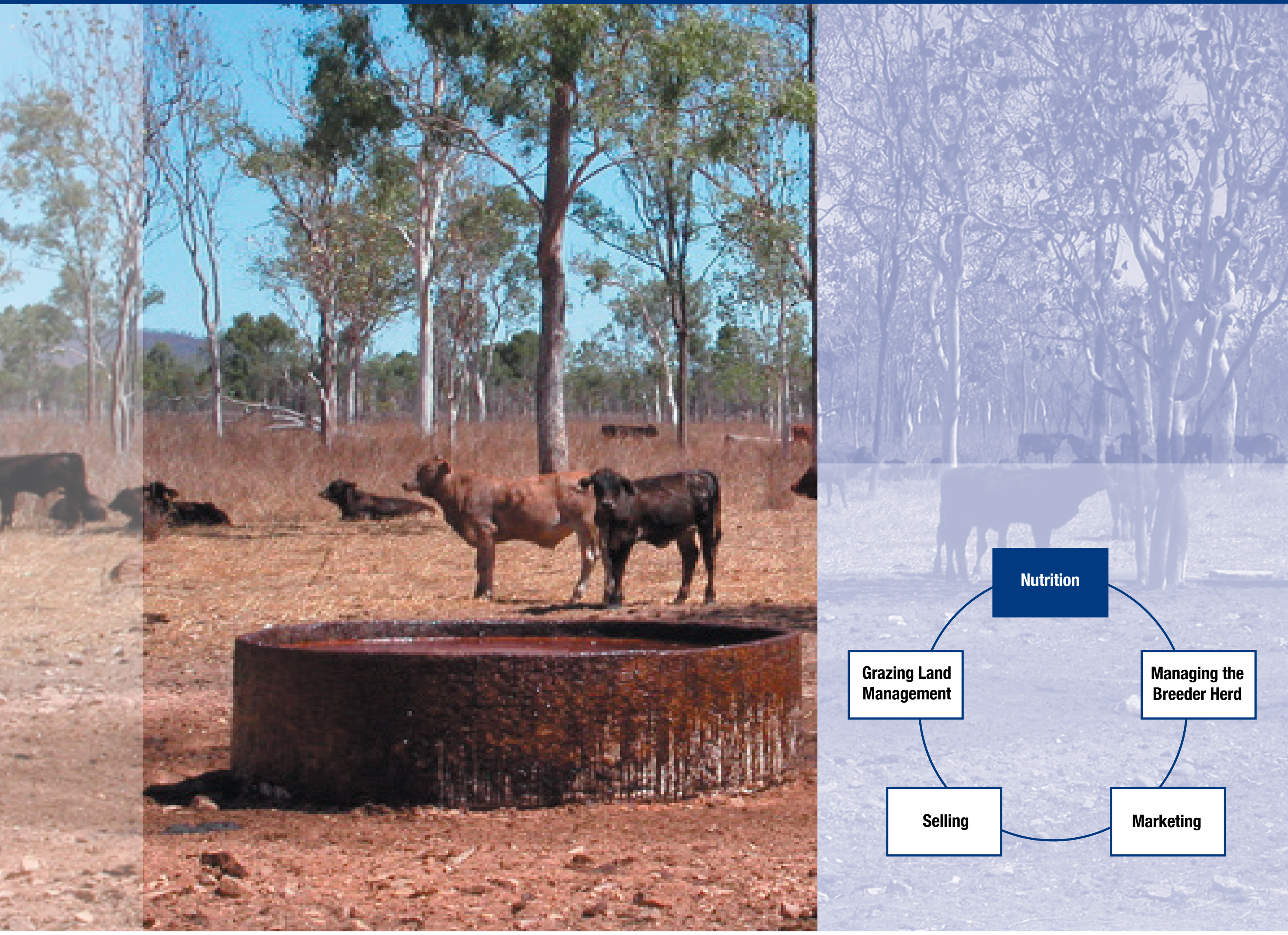
MEAT & LIVESTOCK AUSTRALIA



Beef cattle nutrition

An introduction to the essentials

Queensland Government

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Beef cattle nutrition

Contents

A Quick Quiz to start you thinking

Do I understand the basic principles of my nutrition program or are there things I could be doing better? – a quick self assessment guide.

1. The EDGE network is:

a. A Stephen Steilberg thriller set in the French Alps.
b. A group of cut throat razor enthusiasts who meet every year in Yeppoon.
c. An acronym for a weight watchers group in Eidsvold – Even Dad Gave-up Eating.
d. A set of highly developed educational packages produced by MLA to help beef producers manage their business operation.

2. Adding 1 gram of Urea to a supplement is equivalent to including approximately how many grams of crude protein to the ration:

a. 1 g.
b. 2.87 g.
c. 6.25 g.
d. 100 g.

3. Which statement on microbial protein (the protein contained in bugs in the rumen) is true:

a. It supplies all the protein requirements of a beast at all stages of production.
b. It is absorbed in the true stomach of a ruminant.
c. It can not routinely supply all the protein requirements of young calves and breeder cows producing lots of milk.
d. All of the above.

4. Which statement on phosphorus supplementation in northern Australia is false:

a. Can improve liveweight gains in growing animals by up to 40 kg over the wet season.
b. Provides no improvement to liveweight gains over the dry season.
c. Should be included in both dry and wet season supplements.
d. Should always be included with grain supplements as grain is low in phosphorus.

5. Which statement is true:

a. Tropical grasses have higher protein levels than temperate grasses.
b. Tropical grasses are more digestible than temperate grasses.
c. Tropical grasses require less soil nitrogen to grow than temperate grasses.
d. Tropical grasses have a lower magnesium content than temperate grasses.

6. A 400 kg breeder cow that is producing 8 litres of milk a day will require:

a. The same amount of feed as a dry cow that is maintaining weight.
b. About one and a half times as much feed as a dry cow maintaining weight.
c. About twice as much feed as a dry cow that is maintaining weight.
d. None of the above.

Do I need to read this book?

One of the key activities of Meat and Livestock Australia (MLA) is to ensure that beef producers are able to access and implement the latest research results and management recommendations for their enterprise. A basic understanding of 'why' and 'how' things happen is fundamental to adoption of any new technology.

Leading researchers and extension officers in the various fields have developed a series of educational workshops and comprehensive training manuals, combined into a package called the *EDGEnetwork*. Much of the information contained in this booklet is extracted from The Nutrition EDGE manual. It was specifically designed to assist producers to understand the feed requirements of their livestock and to assist in development of supplementation strategies and ration formulation. It utilises basic nutrition principles and provides feed values for most of the commonly used feed stuffs encountered in rearing and growing beef cattle.

It is the hope of MLA that producers who read this booklet will be better informed on the nutrient values of their pastures and be able to place a dollar value on all the nutritional inputs required to meet their production targets. Furthermore, it is envisaged that it may encourage enthusiastic operators who are keen to understand their business, to participate in a 3-day Nutrition EDGE workshop. In a workshop environment, they will explore and develop in greater depth, the basic principles introduced in this booklet – the ultimate aim being to cost effectively feed and nourish their stock.

Basic digestive anatomy and function

An understanding of the components and development of the digestive tract of cattle is important to understand cattle nutrient requirements and how best to meet these.

The majority of feed available to grazing animals is high in fibre. That is, the feed contains large structural carbohydrates such as cellulose. Very few animals, and no mammals, have the enzyme systems necessary to digest fibre. However, certain microorganisms do have these enzymes.

Ruminants are mammals that have evolved a specialist digestive system that enables them to utilise high-fibre diets such as grass. This digestive system makes use of fibre-digesting microorganisms. The majority of these microorganisms live in the rumen and reticulum.

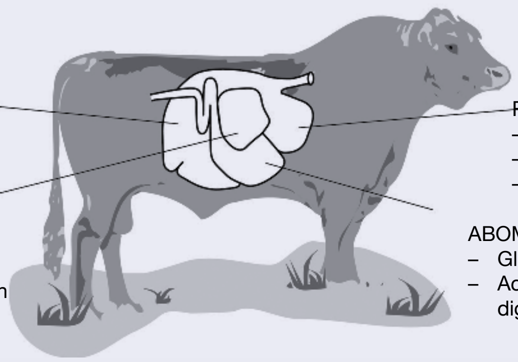
Ruminants such as cattle and sheep are more efficient at converting grass into meat (and wool) than simple stomach animals such as pigs. However, the ruminant digestive system is less efficient than the monogastric digestive system at digesting high-energy diets, such as grain.

Key points to note are:

- ruminants, such as cattle and sheep, have a complex digestive system. They have four stomachs and each does a different job (this is different to monogastrics such as pigs and people that only have one stomach)
- the rumen changes as the animal grows
- balancing the nutrient requirements of both the rumen microorganisms and the animal is essential for good animal performance.

Chewed food is transferred from the mouth to the rumen via the oesophagus. The oesophagus also conveys partially digested food (the cud) from the rumen to the mouth where it is further ground by chewing to make it easier to digest.

Rumen and reticulum



The rumen and reticulum act as a fermentation vat in which plant material is broken down by millions of microorganisms.

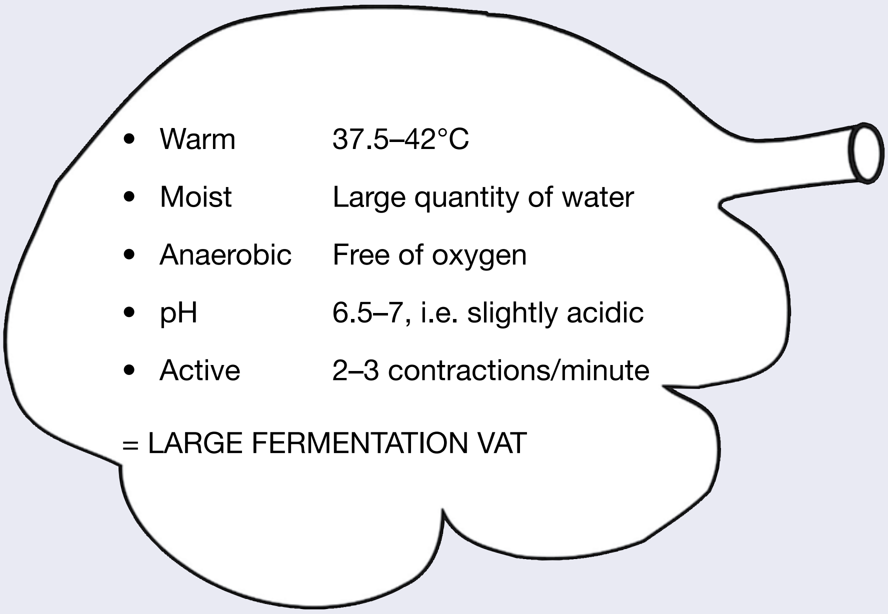
Between 60 and 70% of all digestion happens in the rumen. In summary, fibre is broken down and much of the protein ingested is converted to microbial protein. The rumen is also the site where carbohydrates are fermented to volatile fatty acids, which are then absorbed across the rumen wall where they enter the blood stream and are converted in the body to glucose and fat.

At birth, a calf's rumen is very small and doesn't function. It develops and grows quickly so that, by the time the calf is about eight weeks old, its rumen is able to break down plant material.

Microorganisms require rumen conditions to remain within a specific, limited range to function properly. The rumen fluid should be slightly acid (pH 6.5 to 7.0) and there should be a plentiful supply of ammonia and carbohydrates to feed the microbial population. The microbes also require an anaerobic (oxygen free) environment.

Obviously, the type of feed available to the animal will influence these factors. For example, mature dry grasses will be low in protein and carbohydrate, thereby limiting microbial growth. Conversably high grain diets can lead to high acidity (low pH) that is toxic to many rumen microorganisms and will also compromise microbial growth and digestion.

Ideal rumen environment



The inter-dependency between the rumen microbes and the ruminant animal is a good example of a symbiotic relationship. The grazing animal provides the home (the rumen) and harvests the forage; the microbes digest the forage to supply the nutrients for their own growth and reproduction. Nutrients that are not utilised by the microbes, and the microbes themselves, supply the all the nutrients for the animal's growth and reproduction.

Omasum

The detailed function of the omasum is not well understood. It appears to be involved in reducing the amount of water passing out of the rumen with the partially digested plant material, in further grinding the food and in squeezing the digesta through to the abomasum.

Abomasum

The abomasum is the true, gastric stomach of the animal, similar in function to the stomach of monogastric animals (e.g. pigs) and people.

Protein and some fats are digested in the abomasum with the aid of hydrochloric acid and enzymes

Small intestine

The small intestine is the main site for the digestion and absorption of amino acids, fats and the limited amount of glucose that may be available. The bile and pancreatic ducts open into the small intestine, delivering enzymes, solvents, buffers and other agents (such as sodium bicarbonate) to aid the process of digestion.

Large intestine

The large intestine consists of the caecum, colon, rectum and anus. Some breakdown of feed by microorganisms takes place in the large intestine but the products are generally not absorbed. The primary role of the large intestine in ruminants is to absorb water and to collect waste material from digestion prior to defecation.

What are nutrients?

A nutrient is a substance that provides nourishment or sustenance. There are five broad categories of nutrients required by a beast.

- Water
- Energy
- Protein
- Minerals
- Vitamins

Plants are made up of:

- water
- carbohydrates
  - Structural (e.g. cellulose and hemi-cellulose)
  - Non-Structural (e.g. simple sugars and starches)
- protein
- minerals
- fat.

These plant components are digested to produce:

- volatile fatty acids (VFAs)
  - acetic
  - propionic
  - butyric
- proteins
  - microbial amino acids
  - plant amino acids
- fat (lipids)
  - fatty acids
  - triglycerides
- carbohydrates
  - glucose.

Energy units

- 1 calorie (Cal) = 4.184 Joules (J)
- This is the amount of heat required to raise the temperature of one gram of water from 16.5°C to 17.5°C.

- 1 kilojoule (KJ) = 1,000J
- 1 megajoule (MJ) = 1,000,000J

Terms that will be used

ME – Metabolisable Energy

RDP – Rumen Degraded Protein

UDP – Undegraded Dietary Protein – (bypass protein)

VFA – Volatile Fatty Acids

MJ – Megajoules

Water

Daily water requirements of beef cattle and sheep:

Beef cattle [(a)]		Sheep [(b)]	
Liveweight (kg)	Water req (L) (32°C)	Liveweight (kg)	Water req (L) (35–43°C) dry pasture
Growing heifers, steers and bulls			Weaners
200	36	20-30	3–5
350	57		
Finishing		Late-pregnant ewes	
300	54	45-55	4–7
450	78		
Lactating cows		Lactating ewes	
400	60	40-55	6–9
Mature bulls		Adult wethers and dry ewes	
730	78	50-60	3–5

(a) Nutrient requirements of Beef Cattle, Sixth Edition (1984)
(b) Australian Sheep and Wool Handbook, Ed. Cattle, D.J. Inkarta Press (1991)

Note: Water requirements will increase with increasing temperature. Feeding supplements high in salt will increase water requirements. Water intake will decrease with increased levels of contamination (salt or organic matter) in the water. This can have an adverse effect on animal production. Ewes raising twin lambs require 50% more water than with a single lamb.

Water quality, at least with regard to chemical composition, is primarily related to total dissolved solids (salinity) and nitrate content.

Guide to use of saline water

Total Dissolved Solids of saline water (TDS mg/l or ppm)

Less than 1,000ppm	fresh water	Presents no serious burden to livestock.
1,000–2,999ppm	slightly saline	Should not affect health or performance but may cause temporary mild diarrhoea.
3,000–4,999ppm	moderately saline	Generally satisfactory, but may cause diarrhoea, especially on initial consumption.
5,000–6,999ppm	saline	Can be used with reasonable safety for adult ruminants but should be avoided for pregnant cattle and baby calves.
7,000–10,000ppm	very saline	Should be avoided if possible. Pregnant, lactating, stressed or young animals can be affected.
Greater than 10,000ppm	brine	Unsafe, should not be used under any conditions.

Energy

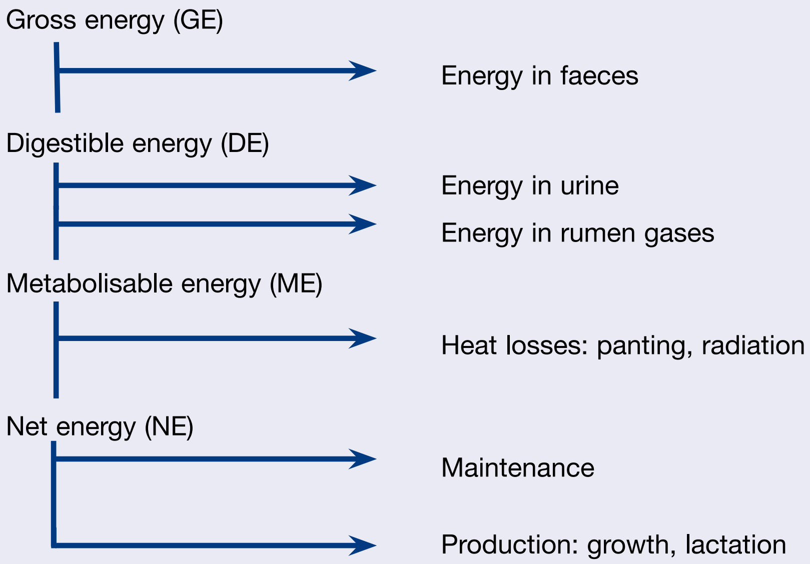
The energy content of a food for animals is not a discreet substance that can be measured in the laboratory like protein or phosphorus. It represents the capacity of the various components of the food to allow the animal to perform its regular functions, for instance to move muscles, to metabolise nutrients and to produce heat.

The major components of the food that contribute to its energy content are carbohydrate, fat and protein. For convenience we combine these when we talk of the energy demands of an animal, but the different components provide different amounts of energy to the animal and are used in different ways by the animal.

While strictly speaking energy is not a nutrient, it is common practice to include it under nutrients when discussing the total nutrient requirements of animals.

Partition of feed energy

The flow diagram below illustrates how the energy in a feed is lost as it passes through the animal – starting with gross energy and finishing with net energy that is actually used by the beast for maintenance, growth, milk and pregnancy.



Which has the most energy?

Grain or straw? This table shows how grain and straw contain the same amount of gross energy but a beast can metabolise (utilise) much more of the energy in the grain than in the straw.

	Type of feed	
	Grain	**Straw**
Gross energy (MJ/kg DM)	18	18
Digestibility (%)	90%	40%
Digestible energy (MJ/kg DM)	16.25	7.2
Metabolised (%)	80%	80%
Metabolisable energy (MJ/kg DM)	13	5.8

* DM = Dry Matter

Acomparison of the key energy components in some feeds

Dry matter: The component of the feed that remains after all of the water has been removed.

Dry matter digestibility: Provides an indication of the portion of energy in the feed that is able to be digested or broken down by the digestive system.

Metabolisable energy: Is the amount of energy that is available to the beast for its metabolism or body functions

The metabolisable energy content of some common feeds

Feed	Description	DM	Digestibility %	ME MJ/kg DM
Grain		90%	90	13
Molasses		75%	90	13
Tropical grasses				
Phase 1	Early, rapid growth	Low (<30%DM)	70	10
Phase 2	Beginning to grow stem, mostly green	Medium (30-50%)	60	8.5
Phase 3	Flowering and seed set, growth slows, 10 to 30% green	Medium/High (50-70%)	55	7.5
Phase 4	Senescence, no growth, no green	High (>80%)	50	6.5

NOTE: Figures for pasture are an estimate of the diet quality selected by grazing animals on pasture at various stages of maturity.

Energy

Cattle use energy for a variety of functions in the body, namely:

- maintenance
- growth
- pregnancy
- lactation.

Energy for production (growth)

Obviously if energy intake does not meet maintenance requirements the animal will not be able to gain weight. Rather they will loose weight, using the energy released for maintenance.

To gain one kilogram of weight, cattle need between 35 and 45 MJ ME above that required for maintenance, depending on the stage of production. Younger cattle tend to lay down more protein (muscle) than fat so have a lower energy demand for growth, whereas more mature cattle tend to lay down more fat so have a higher energy demand for the same rate of gain. (Fat has 2.5 to 3 times the energy content of muscle).

Energy for production (reproduction)

Energy for pregnancy and lactation is a more complex issue. Even if energy intake is inadequate, the female cannot shut down a pregnancy or milk production although the energy available for either function is reduced. Rather she will begin to loose weight, using the energy released for maintenance of the foetus and/or milk production. In extreme cases the break down of products from this weight loss can cause metabolic disturbances, especially in sheep.

Relative energy requirements during pregnancy and lactation

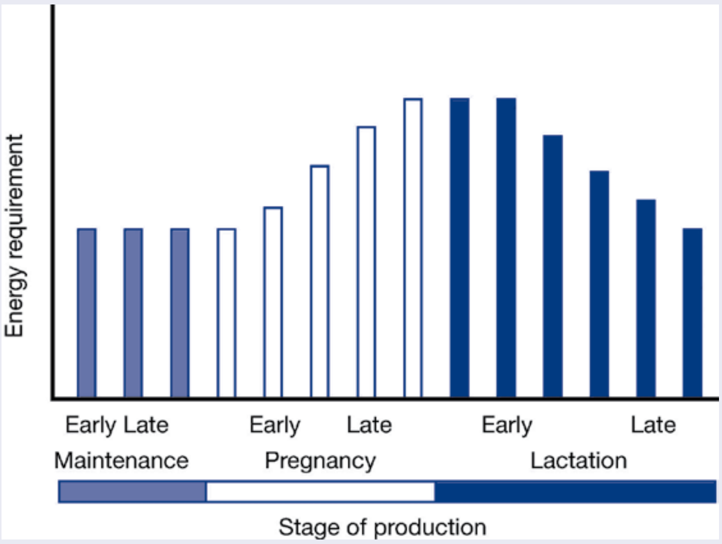


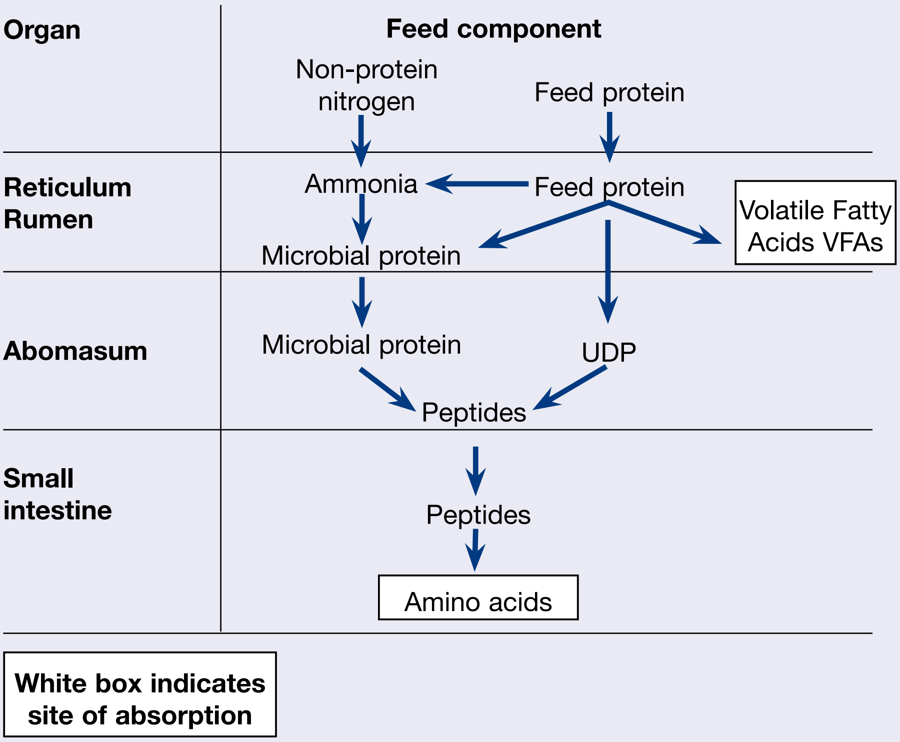
Table 1. Metabolisable energy requirements (MJ/day) of cattle for maintenance and growth

ME of diet (MJ/kg DM)	Liveweight (kg)	Liveweight gain (kg/day)						
		0	0.2	0.5	0.75	1.00	1.25	1.50
5	100	19	25	35	–	–	–	–
	200	31	38	53	–	–	–	–
	300	40	53	69	–	–	–	–
	400	48	63	83	–	–	–	–
	500	58	73	108	–	–	–	–
	600	64	82	109	–	–	–	–
7	100	18	23	31	43	–	–	–
	200	29	36	47	62	–	–	–
	300	38	48	61	80	–	–	–
	400	46	58	73	96	–	–	–
	500	54	67	85	111	–	–	–
	600	61	76	96	126	–	–	–
9	100	17	22	27	35	47	–	–
	200	27	34	42	52	66	–	–
	300	36	44	54	67	85	–	–
	400	44	54	65	81	103	–	–
	500	51	62	76	94	119	–	–
	600	58	71	86	107	134	–	–
11	100	16	20	25	31	38	49	66
	200	26	31	38	46	56	70	89
	300	34	41	50	60	73	89	112
	400	42	50	60	73	88	108	135
	500	48	58	70	84	102	125	156
	600	55	66	79	95	115	141	176
13	100	15	19	23	28	33	41	51
	200	25	30	35	42	50	60	72
	300	32	39	46	55	65	77	92
	400	40	47	56	66	78	93	111
	500	46	55	65	77	91	108	129
	600	52	62	74	87	103	122	145

Protein

Ruminants have the ability to synthesise protein from non-protein nitrogen (NPN) sources. Most of the true protein that ruminants ingest is broken down by the rumen microorganisms and resynthesised as microbial protein.

Protein digestion and absorption



The concept of microbial growth using non-protein nitrogen (NPN) is one of the most important in ruminant nutrition. Microbial protein makes up approximately 70% of all protein absorbed from the small intestine.

The protein percentage can be calculated by multiplying the nitrogen (N) percent by 6.25. For example:

- Urea at 46% N multiplied by 6.25 equals 287% protein
- Gran-Am at 20% N multiplied by 6.25 equals 126% protein
- grass at 1.2% N multiplied by 6.25 equals 7.5% protein.

The basic process of protein in digestion and absorbtion

1. The degradable fraction of the feed protein is broken down in the rumen to ammonia (NH_3) and volatile fatty acids.

2. Urea, ammonium sulphate and other NPN sources can also be used as an ammonia supply.

3. The rumen microorganisms then use the ammonia to build their own bodies, i.e. synthesis of microbial crude protein (MCP). When the microbes are washed from the rumen the MCP is digested in the abomasum. The resultant amino acids are absorbed in the small intestines.

4. Energy is needed to drive MCP production in the rumen. Approximately 12 MJ ME is required for the growth of 100g of MCP.

5. The process is also dependant upon the availability of Rumen Degradable Protein (RDP). There are inefficiencies associated with the conversion of dietary protein to MCP. These inefficiencies are largely related to the digestibility of the feed.

6. Obviously, the available energy and protein need to be in balance. If energy is deficient, the now surplus ammonia will be lost via the urine. Similarly, if protein is deficient the surplus energy will be used inefficiently in other metabolic processes.

7. There is also an upper limit to the rate of microbial protein synthesis. If RDP is surplus to this requirement, the excess ammonia will be lost via the urine and the carbon chain used as an energy source by the animal. This is rarely encountered under grazing conditions in northern Australia but can be seen on high protein forages like lucerne or rye grass.

8. This upper limit on MCP synthesis has implications for high producing ruminants, e.g. dairy cattle and rapidly growing young stock (gaining 1.5 kg/day) where they have a requirement above that provided by the RDP to MCP conversion. Under these circumstances the extra protein can only be delivered by protein that is not degraded in the rumen (UDP) but flows through to the abomasium where it is then digested similar to MCP.

Protein

Proteins are required for almost all body functions. Requirements vary according to:

- age
- growth rate
- pregnancy and lactation status.

Undegraded dietary protein (UDP) or bypass protein

Undegraded dietary protein or bypass protein is protein that is not degraded in the rumen and passes directly into the small intestine where it can be used directly by the animal.

Young animals have a high requirement for protein, as a significant proportion of their growth is muscle. Similarly cows in late pregnancy have to supply protein to the rapidly growing foetus.

Protein is a significant and important component of milk. Therefore lactating cows have a higher protein requirement to meet the demand of milk production.

Often the high protein requirements of fast growing young animals and cows in late pregnancy or early lactation cannot be met by MCP alone. In such situations these animals have a requirement for undegraded dietary protein (UDP).

Table 2. Rumen degraded protein (RDP) and undegraded dietary protein (UDP) requirements (g/day) of cattle for maintenance and growth

ME of diet (MJ/kg DM)	Liveweight (kg)	Form of protein	Liveweight gain (kg/day)						
			0	0.25	0.50	0.75	1.00	1.25	1.50
5	100	RDP	155	200	270	–	–	–	–
	200	RDP	245	315	415	–	–	–	–
	300	RDP	315	400	525	–	–	–	–
	400	RDP	385	495	640	–	–	–	–
	500	RDP	450	575	760	–	–	–	–
	600	RDP	505	640	845	–	–	–	–
7	100	RDP	140	180	240	335	–	–	–
		UDP			15				
	200	RDP	225	285	365	485	–	–	–
	300	RDP	295	370	470	620	–	–	–
	400	RDP	360	450	570	750	–	–	–
	500	RDP	420	525	665	865	–	–	–
	600	RDP	475	595	750	980	–	–	–
9	100	RDP	130	165	215	275	365	–	–
		UDP		5	35	50	35		
	200	RDP	210	260	325	405	520	–	–
	300	RDP	280	345	425	525	665	–	–
	400	RDP	340	415	515	635	800	–	–
	500	RDP	395	485	595	735	930	–	–
	600	RDP	450	550	675	835	1,050	–	–
11	100	RDP	125	155	195	240	300	385	510
		UDP		15	50	80	90	80	30
	200	RDP	200	245	295	360	440	545	690
	300	RDP	265	320	385	470	565	695	875
	400	RDP	325	390	470	565	685	840	1,055
	500	RDP	380	455	545	660	795	975	1,220
	600	RDP	430	515	620	745	900	1,110	1,370
13	100	RDP	120	145	180	215	265	320	395
		UDP		20	65	95	120	130	120
	200	RDP	190	230	275	330	390	465	560
		UDP				15	20	10	
	300	RDP	255	305	360	425	505	600	720
	400	RDP	310	370	435	515	610	725	870
	500	RDP	360	430	510	600	710	840	1,005
	600	RDP	410	485	74	680	800	950	1,135

Adapted from ARC (1980}

Intake of feed

Intake is the most important factor influencing the level of nutrient supplied to the animal. Intake is usually referred to in terms of dry matter (i.e. the non-water component of feed) and is often expressed as a percentage of body weight, e.g. a 400 kg steer eating 10 kg of dry matter has a dry matter intake of 2.5% of body weight.

Always compare feedstuffs on a dry matter basis for:

- **all budget exercises**
- **ration formulation**
- **purchasing of feed.**

Dry matter (DM)

Component of a feed left after drying

Molasses	75% DM	1 kg as fed	750g DM
Grain	90% DM	1 kg as fed	900g DM
Silage	50% DM	1 kg as fed	500g DM

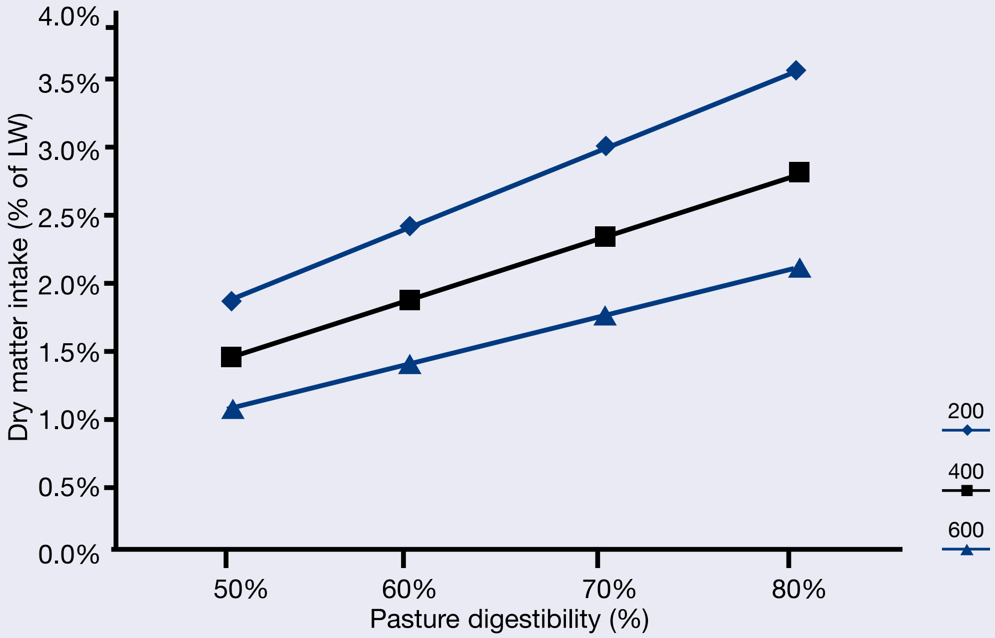
Dry matter intake (DMI)

A number of factors influence dry matter intake:

Given these influences, the factor with the most impact on intake is the digestibility of the diet. Low quality diets, e.g. dry winter feed, will only allow intakes around 1.5% of body weight while cattle on high quality diets, e.g. feedlot, will consume up to 3.0% of body weight.

Low level protein supplementation will increase the intake of poor quality low protein diets by up to 30%.

Estimated dry matter intake of 200, 400 and 600 kg steers for a range of pasture digestibilities



Primary limiting nutrient

One of the key principles to understand in animal nutrition is the principle of the primary limiting nutrient. When animals graze, attaining a particular production goal can be restricted by inadequate supply of one or more nutrients, e.g. protein, energy and minerals. But animal performance is primarily limited by the availability of the most limiting nutrient, i.e. the primary limiting nutrient.

The supply of nutrients other than the primary limiting nutrient will have no affect on performance until the primary limiting nutrient deficiency is corrected.

As an example of a primary limiting nutrient cattle on low phosphorus soils will respond to phosphorus supplementation in the wet season but not in the dry season. This is because in the dry season protein and energy, not phosphorus, are the primary limiting nutrients.

What does pasture cost?

What is it about pastures that makes them important for beef production? How do pastures compare with other feed sources, such as grain, hay, silage or forage crops?

What does pasture cost?

Agistment example (a)

Agistment cost	$3.00/head/week
	$0.43/head/day
Dry matter intake	10 kg/head/day
Feed cost	$0.043/kg DM consumed
	$42.86/tonne DM consumed

Capital based example (b)

Capital based costings	Improved pasture	Native pasture
Land value	$1,500/ha	$650/ha
Opportunity cost @ 6%	$90/ha/year	$39/ha/year
Maintenance cost	$15/ha/year	$0/ha/year
Annual cost	$105/ha/year	$39/ha/year
Dry matter production	6,000 kg/ha/year	3,500 kg/ha/year
DM utilisation	45%	30%
DM consumed	2,700 kg/ha/year	1,050 kg/ha/year
Feed cost	$0.039/kg DM consumed	$0.037/kg DM consumed
	$39/tonne DM consumed	$37/tonne DM consumed

In both examples above the cost of pastures is approximately the same

The relative cost of grass is about 4c/kg DM consumed.

Compare this with:

- feedlot ration @ 30c/kg DM or $300/tonne
- hay @ 15c/kg DM or $150/tonne
- whole cotton seed @ 38c/kg DM or $375/tonne.

Now consider the relative conversion ratios for different feeds:

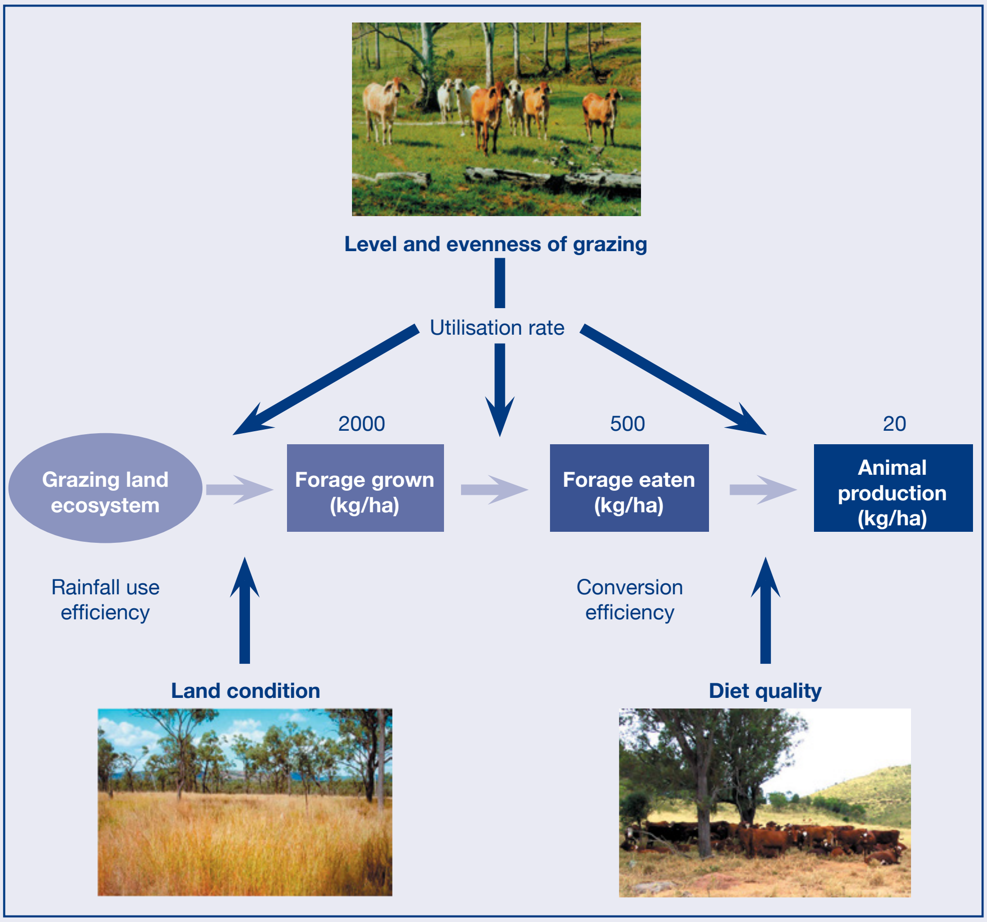
- grain converts to beef @ 6:1
- grass converts to beef @ 20:1.

The cost of feed required to produce 1 kg of liveweight gain is called the feed cost of gain (FCOG). It is simply derived by multiplying the dry matter cost of the ration by the feed conversion ratio (FCR). i.e. FCOG = DM x FCR = 4 x 20 (grass) = 80 cents per kg.

THUS the relative cost of liveweight gain (LWG) is about $0.80/kg for grass compared with $1.80/kg LWG for grain.

Pasture – the cheapest source of cattle feed

Beef production can be seen as a set of steps in a production chain. In very simple terms grazing land grows forage, forage is eaten by stock and converted to beef, which is converted at some stage into money. The efficiency of this system (up to the beef produced stage) is effectively regulated by three gateways.



The gateways model for grazing land production systems.

The three gateways are:

1. Rainfall use efficiency gateway: The efficiency of the production chain at this gateway (i.e. the production of useful forage) can be influenced and managed by optimising land condition.
2. Utilisation rate gateway: The production chain can be regulated and manipulated through this gateway by optimising the level and evenness of grazing.
3. Conversion efficiency gateway: The efficiency of the production chain can be managed at this gateway by optimising diet quality.

Measures of pasture quantity and quality

Quantity Pasture quantity is measured in kilograms of dry matter per hectare (kg DM/ha). The dry matter of a pasture will vary with stage of growth and species. Young green pasture can be about 20% dry matter (80% moisture) while mature pasture can be 80–85% dry matter (15–20% moisture); hay is generally about 20% moisture or less.

To determine the dry matter content of pastures cut samples are put into paper bags and dried in dehydrator ovens at 80°C for 24 to 48 hours. Alternatively, you can place samples of pasture in a microwave oven with a glass of water and repeatedly heat the pasture on high, measuring its weight each time, until there is no appreciable reduction in the sample's weight. The sample's final weight divided by its initial weight, expressed as a percentage, gives the pasture's dry matter content.

Quality Pasture quality is a measure of the concentration of nutrients in samples of pasture. By far the most important nutrients are energy and protein. The three important measures of pasture quality are:

- digestibility (%)
- metabolisable energy (ME) (measured as Megajoules (MJ)).
- protein content (%).

What are the main factors to influence quantity and quality of pasture that grows in the paddock?

Principles of pasture growth (quantity) and its quality

Pasture growth is seasonal and quality closely follows this seasonal pattern. The growth pattern of pasture plants is controlled by seasonal fluctuations in:

- water availability
- temperature
- day length.

The important feature is that the seasonal pattern of growth, and hence quality, results in large variations in plant quantity and quality. For many native pastures, quality decline is rapid after flowering commences. Frosting reduces plant quality even further. Water is the most limiting environmental constraint to pasture growth. Temperature, both high and low, will also limit growth. In the tropics and subtropics, cattle growth rates closely follow changes in pasture growth associated with rainfall.

Water availability for pasture growth is affected by:

- rainfall (varies according to intensity and seasonality)
- soil infiltration (regulated by soil type and structure, slope and ground cover)
- soil water holding capacity (determined by soil type and clay content – see below).

Rainfall use efficiency (RUE = kg DM grown/ha/mm rain) is a useful measure of how rainfall is converted into pasture growth and can be used to compare land types and their condition.

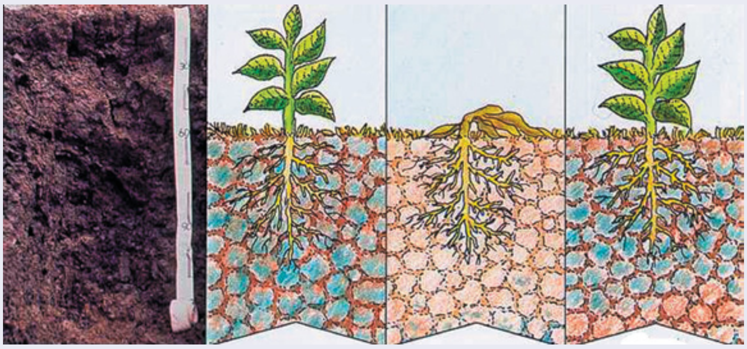
Other factors that have a major influence on pasture growth and quality are:

- land type
- pasture age.

Land type

A land type is described from the original vegetation and soil types. It is usually a broad association of trees and soils, e.g. silver-leaved ironbark on clay. Soil type determines the soil's water holding capacity and its wilting point. Soils with higher clay content have higher water holding capacities but also have higher wilting points. Sands can hold less water but nearly all the moisture is available for plants (low wilting point).

Pasture type and species



Soil texture	Field capacity	Permanent wilting point	Plant available water content
Well-structured clay	500	300	200
Clay	380	240	140
Loam	340	120	220
Sandy loam	230	90	140
Sand	90	20	70

Source: DPI (1992) Understanding Soil Ecosystem Relationships

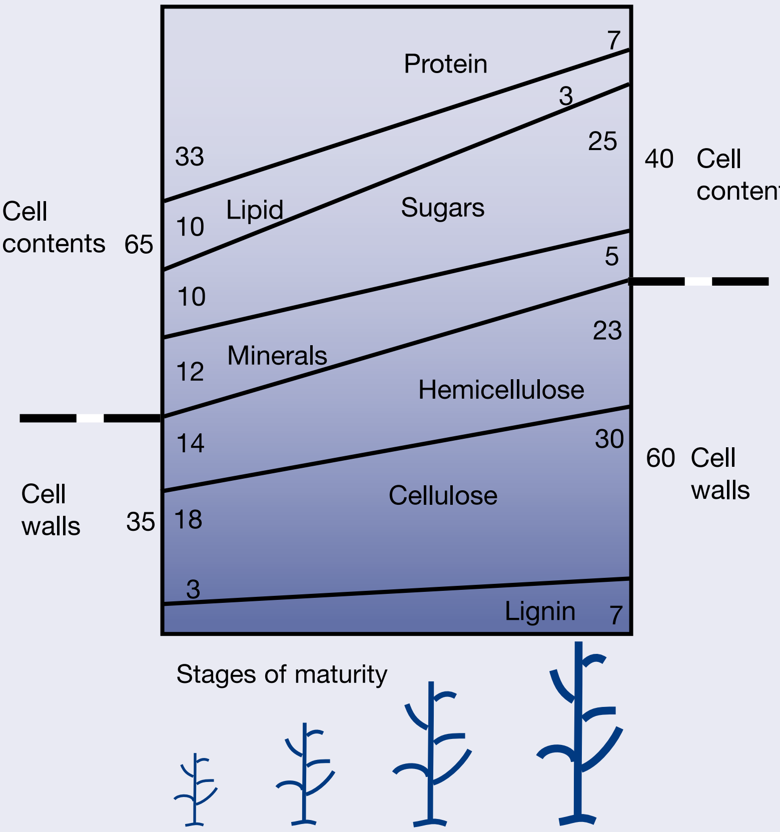
Ability of different soils to provide plant-available water (millimetres water to one metre of depth)

Different soils have different levels of inherent fertility. Each has a natural limit to the amounts of various nutrients it can make available to plants. The availability of nutrients to the plant can be maximised through management. Ensuring high levels of soil organic matter will enhance soil structure, water holding capacity and nutrient cycling. The key to maintaining high levels of soil organic matter is to only graze a small proportion of pasture (25% to 30%) leaving plenty to protect the soil and remain as organic matter.

Generally, as pastures age:

- digestibility decreases
- metabolisable energy (ME) decreases.

Changes in the chemical composition of grasses as they age (% composition of cells)



Four phases of pasture growth and development

- Phase 1, when plants are growing rapidly producing high quality green leaf. Pastures are most nutritious in Phase 1 but are susceptible to overgrazing. Pasture quality may restrict intakes of grazing cattle.
- Phase 2 grasses begin to grow stem that is lower quality. They are less susceptible to grazing and quality is higher. This is the most favourable stage for grazing pastures.
- Phase 3 grasses set seed and quality declines rapidly. Pasture bulk is usually not limiting in this phase. Little growth will occur from now on.
- Phase 4 pastures become dormant. Quality is low and declines further with frosting.

The decrease in pasture quality as pastures age has a marked effect on cattle productivity. These include:

- the low digestibility depresses intake and increases rumen retention time
- the low ME content reduces cattle performance
- the low protein content reduces the efficiency of microbial fermentation.

Temperate and tropical pastures

Tropically adapted pastures grow in warm seasons and are more efficient in the way they use water. The down side to this is that tropical pastures have more fibre and are less digestible than temperate pastures. Temperate pastures, such as rye grass, are more easily digested by cattle than any of the tropically adapted pastures, such as rhodes grass or black speargrass.

Legumes and grasses

Unlike grasses, legumes have the ability to fix atmospheric nitrogen and are generally of much higher quality, and for longer into the season, than grasses. Young green shoots of speargrass can have protein contents of 15% to 18% whereas the young growing tips of the shrub legume leucaena, can have protein contents of up to 28%. Generally, cattle grazing pastures with high legume contents will have much better diet quality than cattle on unfertilised grass only pastures.

3Ps

These are grasses that are perennial, productive and palatable. A pasture with a high proportion of these grasses (for example, more than 70% by weight) will be in better condition, be more productive and will allow grazing animals better selection.

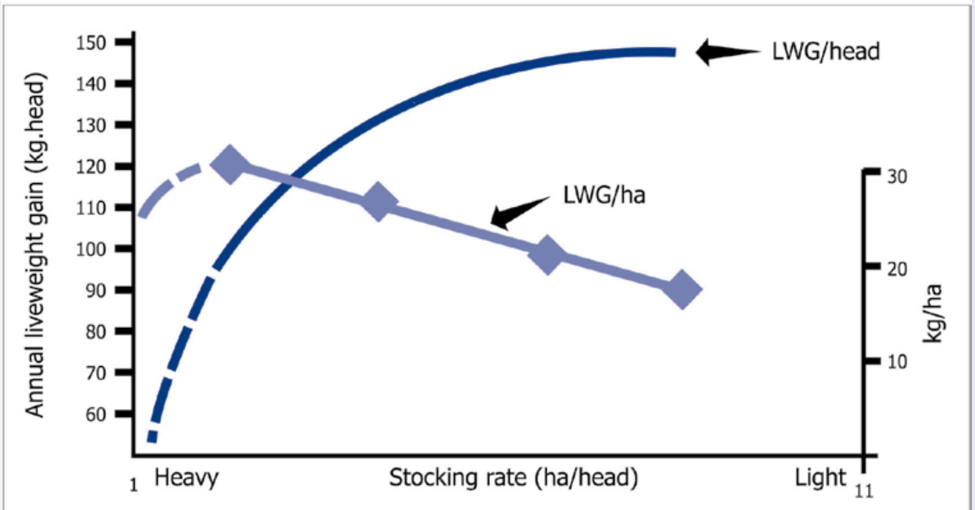
Indicators of pasture quality

The amount of 3P grasses is a good indicator of pasture quality for cattle production. Also, leafiness is an indicator of plant quality (recall that leaf is more digestible than stem and is selected by cattle). Compare a leafy grass (e.g. Queensland bluegrass or black speargrass) with a stemmy grass (e.g. wiregrass).

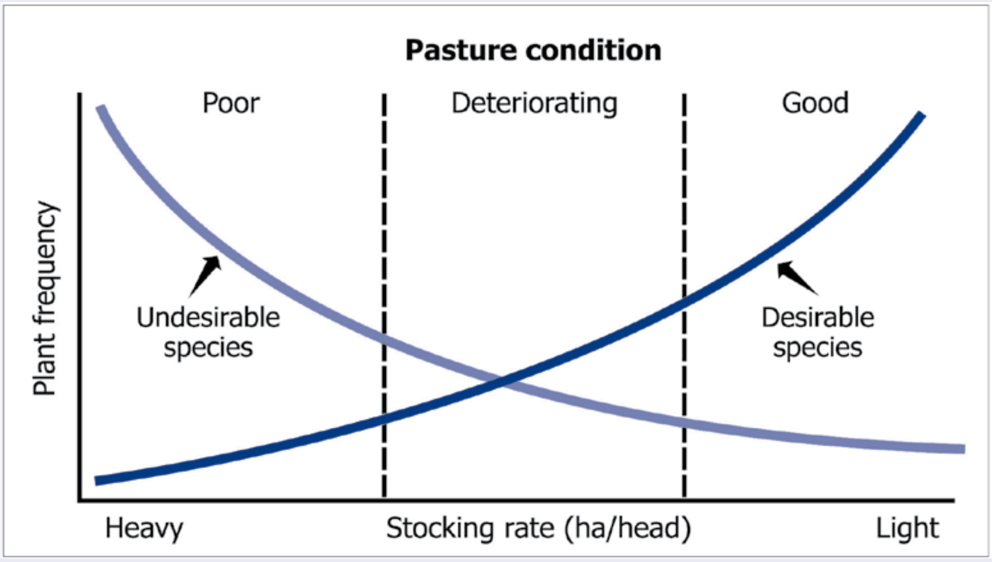
How does stocking rate influence liveweight numbers?

Increasing the numbers of cattle or sheep in a paddock can increase the liveweight production per hectare, but at what expense?

The first and most immediate effect is to reduce liveweight gain per head. This response is well documented by research and is well illustrated in the following graph. The application of principles from this graph to your circumstances can have a large impact on your business.



Liveweight gains per head and per hectare as stocking rates are reduced



Species composition of pastures as stocking rates change

From the first figure above, as stocking rates are reduced from heavy on the left to lighter towards the right, liveweight gains per head are increased significantly. Halving stocking rate can double liveweight gains per head when initial stocking rates are heavy. As stocking rates are further reduced the increase in liveweight gain becomes progressively less. However, reducing stocking rate reduces liveweight gain per hectare.

The other aspect of increased stocking rates is shown in the second figure. In the long-term, increasing stocking rates from light to heavy reduces the desirable species (mostly 3Ps) and increases the undesirables, giving poor condition pastures.

In applying these principles to your business, consider these points:

- if you are stocking heavily, liveweight gain per hectare may be high at the expense of liveweight gain per head
- besides the impact this will have on pasture composition, turnoff cattle will be lighter (at a given age)
- if you want to target markets for heavier cattle, you may have to reduce stocking rate to allow cattle to gain more weight per head
- under heavier stocking rates, which utilise more of available pasture, less desirable pasture species take over. Often these are less productive and mostly they are less palatable
- adjusting utilisation levels of available pasture allows you to manipulate liveweight gain per head and maintain pastures in good condition.

If stocking rates are set at a level that utilises only the leaf from pasture over a 12 month period, then you will be stocked to carrying capacity. This will allow:

- cattle to select the best diet
- pastures to recover after grazing and remain in good condition.

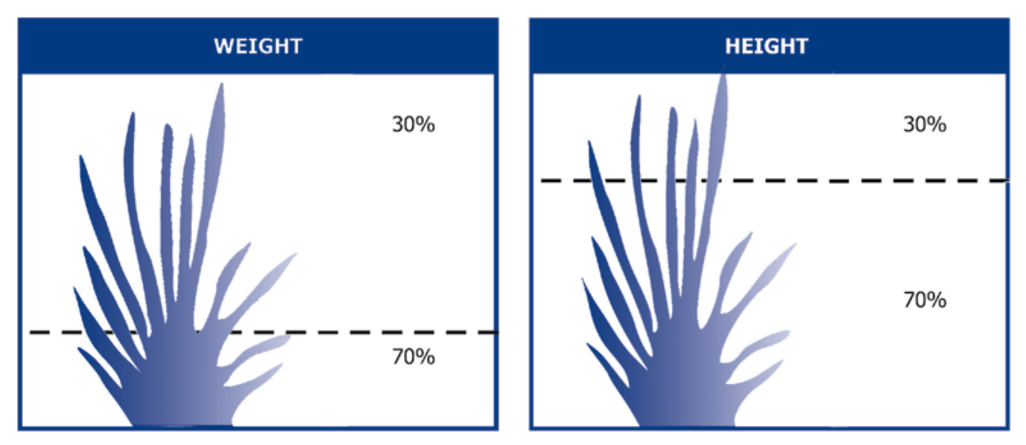
Generally, utilising 15% to 40% of pastures is best for cattle and pastures. The higher levels of utilisation can be used in wetter coastal areas and on sown pastures, while the lower levels are best for infertile soils and drier inland areas.

On average, many pastures can be utilised to the 30% level. What does this look like?

Carrying capacity (CC)

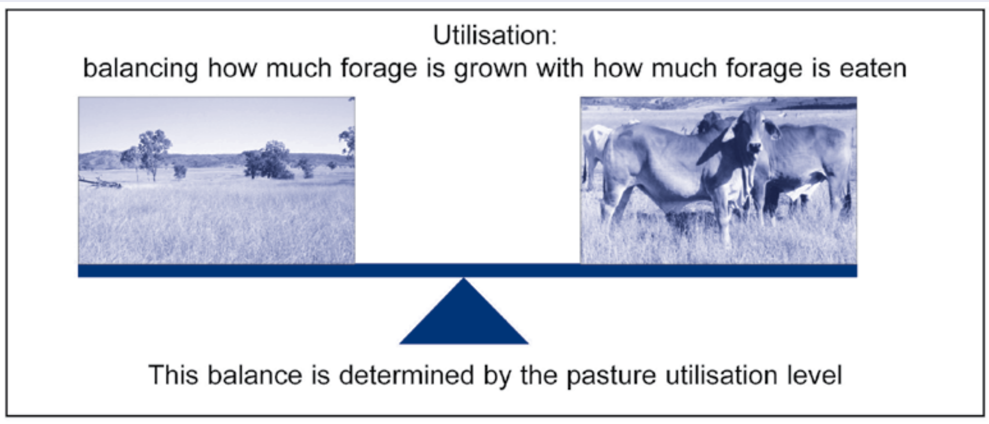
The average stocking rate that land can reasonably be expected to support, given the mix of land types, their condition, the climate, current infrastructure development and proposed grazing system, and given the cattle production and land condition objectives.

What does 30% utilisation look like?



30% use (utilisation) by weight (correct), compared with 30% use by height (incorrect).

Another aspect of utilisation to consider is the distance to water. As distance increases, grazing efficiency is reduced so that stock utilise much less pasture 5km from water than they do 1km from water.



Animal performance can be predicted by knowing the quality of the diet. This will indicate if animals are on track to meeting production targets. This can be important in intensive management, high production systems and when feeding supplements.

Leafiness of the pasture, the amount of green material present and the amount of legumes in pastures are an indication of what the diet quality of grazing cattle and sheep might be. It is however, difficult to assess.

Faecal samples can be analysed in laboratories and diet quality predicted from the results but the time required for analyses is often two or more weeks, by which time, pastures and diet quality has usually changed.

A new technique is providing more rapid analysis of diet quality. Near Infrared Reflectance Spectometry (NIRS) can assist in determining diet quality in a matter of days. The technique relies on matching characteristics of faecal samples with known diet quality relationships from cattle grazing different pasture types. This method of assessing diet quality is still in the development stage.

Principles of choosing a grazing system

When choosing a grazing system to suit your requirements, there are the important things to consider.

- Any system that allows cattle to select green leaf, or leaf in winter when there is no green in the pasture, will give the best result for both cattle and pastures.
- Utilisation level is the most important factor in pasture and cattle production.
- Different grasses produce different proportions of leaf over a growing season, usually 20–40%; lower in native pastures and higher with sown grasses.
- Set annual utilisation levels to suit the land type and locality, or to match the proportion of leaf a pasture grows remembering to discount for poorer species.
- A system of grazing that allows pastures to be spelled in the early growing season every three to four years is good for pasture condition and therefore cattle production in the long-term.
- Cattle tend to utilise pastures closer to watering points (within 1km) more heavily. The spacing of watering points will have a major influence on the evenness of grazing.

Notes on some grazing systems

- Rotational grazing systems can benefit pastures by allowing a spelling period during the growing season.
- Rotational systems also use more fencing and watering points, and thus, improve utilisation by more even distribution of grazing.
- Some rotational systems force cattle to eat all the available leaf and some stem, so cattle production suffers.
- Reducing the grazing period for each paddock in a rotation so cattle always have access to green leaf will improve weight gains.

- Some grazing systems rely on a form of forage budgeting: this improves management of utilisation.
- Spell grazing, where paddocks are spelled for some time during the growing season, once every three or four years, will achieve many of the desirable outcomes without the expensive infrastructure of more intensive systems.

Some of the more common grazing systems

- Continuous, set stocked: where the same number and type of stock are kept in a paddock continuously, irrespective of season.
- Continuous variable stocking: where stock numbers are varied according to season and feed availability.
- Rotational: where cattle are regularly shifted around a series of three or more paddocks.
- Time controlled grazing: where cattle are shifted around a large number of paddocks (20 to 40) in a rapid rotation. Grazing periods can be as little as one or two days for a paddock.
- Spell grazing: uses a system of regular wet season spelling. For example, there might be four paddocks, one of which is spelled during the early growing season each year, so that each paddock is spelled for part of the growing season one year in four.

Determining livestock numbers using adult equivalents

An adult equivalent (AE) is a relative measure of the intake of different classes of animals. AEs reduce all classes and sizes of cattle into a common adult, allowing meaningful comparisons to be made.

When using AEs it is important to note that the intake of younger (smaller) cattle is higher in proportion to their body weight than older (and larger) cattle.

one AE = one 450 kg dry animal at maintenance.

There are a number of other systems used to compare animals. The most common of these are dry sheep equivalent (DSE) and livestock units (LSU). When using these systems it is important to always make comparisons using the same system, i.e. SE with SE and DSE with DSE.

Dry sheep equivalent (DSE)

The DSE is derived from the amount of feed needed to keep a 50 kg wether at maintenance condition' (NSW Agriculture 1994).

1 DSE x 9.0 = AE

Using AEs

AE ratings can be used as a convenient guide to:

- estimate the potential carrying capacity and therefore, income that can be generated from different properties
- make comparisons between livestock enterprises, e.g. compare turning off weaners with three year old bullocks; gross margins can be calculated in dollars per AE
- buying land or stocking newly acquired land.

The limitations of AEs

AE ratings, for the sake of simplicity, are based on bold assumptions. It must be emphasised that they may be misleading if rigidly applied. The values must be kept in perspective and can be used only when the following limitations are taken into account:

- AE ratings ignore variations between animals of the same class
- AEs are a 'snapshot' measure. If the animal is gaining weight, the AE rating must be adjusted
- when AEs are used to calculate the number of a different species (say cattle and sheep) the different grazing habits of both species should be taken into account.

Relative adult equivalents

Dry stock liveweight (kg)	AEs
100	0.30
150	0.40
200	0.50
250	0.60
300	0.75
350	0.80
400	0.90
450	1.00
500	1.10
550	1.15
600	1.20
650	1.30
700	1.40
800	1.50
850	1.60
900	1.70

For breeding females, add 0.3 AE to their liveweight AE to calculate the average AE over a year.

If a paddock can carry 100 AEs then any one group of the following cattle can be carried.

Class of animal	Liveweight kg	AE rating	Number in paddock
Steers	450	1	100
Weaners	250	0.6	166
Bullocks	600	1.2	83
Lactating breeders	400	0.9 + 0.3 (allowance for lactation) =1.2	83

The numbers of the different classes of cattle that can be carried in the same area, as shown above, have been calculated to exert the same grazing pressure on the paddock.

Developing a grazing management plan

Stocking rates, and the timing and duration of grazing and resting, are the major components of grazing plans that can be controlled by the manager.

Grazing management plans involve:

- planning 'when' and 'how long' pastures are grazed and spelled
- allocating 'how many' and 'what classes' of stock planning will go onto a pasture
- the timing of introduction of stock to the pasture and the length of the grazing period.

Decision-making will involve considering the goals set for the pasture (e.g. legume and other species composition and erosion control), stock (e.g. target weight, fat, condition and pregnancy percentage) and manager (e.g. more profitable and productive pastures and stock).

Principles of grazing management

- Plan grazing management; don't let it just happen.
- Consider the effects of stocking rate on liveweight gains per head and the effect this may have on animals reaching target markets.
- Grazing pressure is critical for both cattle and pastures. Stocking to utilise 15% to 40% of pastures, will allow cattle to select what is best for them, leaving enough green leaf for pastures to regrow.
- Do forage budgets regularly and adjust animal numbers according to the feed avail able and the desired utilisation rate. Assess the quality of pasture to see if it is sufficient for cattle to meet production targets.
- Check the grazing pressure in different paddocks using a common base by converting the numbers of cattle in each class to adult equivalents.
- Manage to give a good coverage of 3P grasses.

Pasture composition can be improved by:

- regular spelling in the growing season
- adjusting stocking rates to achieve utilisation rates that are safe for the land type
- occasional fires (particularly in native pastures) to even out grazing and control woody weeds.

Grazing pressure (GP)

Grazing pressure is the relationship between feed on offer and total stock demands (including native and feral animals), with stock preferences causing more or less pressure on some areas or on some plant species in a pasture. AEs and similar standards can be used to quantify stock demand. Kilograms of dry matter per hectare (kg DM/ha) can quantify useful, available feed.

Worksheet 8: Grazing management plan (for participants to complete at home)
(This is one suggested approach for a grazing plan, where applicable.)

Property:________________ Selection:________________ Year: 20 ____ /20 ____

Paddock	Size (ha)	Month:		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total (AE ÷ days)	SR* (ha ÷ AE)
		Planned	AE														
			days														
		Actual	AE														
			days														
		Planned	AE														
			days														
		Actual	AE														
			days														
		Planned	AE														
			days														
		Actual	AE														
			days														
MANAGEMENT ACTIONS DURING YEAR: (e.g. weaning, calving, breeding, sales, supplementation, etc.)																	

* SR (stocking rate) = hectares divided by total AE.

Mineral nutrition of cattle

Minerals are important in the nutrition of cattle and sheep because they are a key component of bone (e.g. phosphorus and calcium for bones). They are also needed for other essential processes and functions which allow animals to live and grow. Potassium and sodium for the osmotic regulation of body fluids. Iron and copper are a component of proteins, most importantly haemoglobin. Zinc and selenium are necessary for optimum growth. Deficiencies of minerals can result in ill-thrift.

Cattle need 22 different elements in correct proportions to thrive: the most important being phosphorus and sulfur. Copper, sodium and cobalt also play important roles.

Both excess and insufficient amounts of minerals can cause problems, either through toxicity or because of secondary effects. As an example, too much sulfur or molybdenum can cause copper deficiency.

Problems of mineral deficiency or over supply usually only occur with unusual diets. With the exception of phosphorus, most minerals are adequately supplied for grazing animals in northern Australia.

Supplementation is the most common means used to correct specific mineral deficiencies, but a balance has to be found between delivering optimal amounts of supplements to grazing animals and keeping down the cost of supplementation.

Vitamin supply is not usually a problem for grazing animals.

Diagnosing mineral deficiencies can be complicated and often requires professional assistance to determine the correct testing procedure and to interpret the test results.

Major minerals

Mineral	Dietary requirement (g/kg DM)	
	Cattle	Sheep
Phosphorus (P)	1.0–3.8	0.9–3.0
Sulfur (S)	1.5	2.0
Calcium (Ca)	2.0–11.0	1.4–7.0
Sodium (Na)	0.8–1.2	0.7–1.0
Magnesium (Mg)	1.3–2.2	0.9–1.2
Potassium (K)	5.0	5.0
Chlorine (Cl)	0.7–2.4	0.3–1.0

(Source: SCA 1990)

Trace minerals

Mineral	Dietary requirement (mg/kg DM)	
	Cattle	Sheep
Copper (Cu	4–14	4–14
Cobalt (Co)	0.07–0.15	0.08–0.15
Selenium (Se)	0.04	0.05
Zinc (Zn)	9–20	9–20
Iodine (I)	0.5	0.5
Iron (Fe)	40	40
Manganese (Mn)	20–25	20–25

(Source: SCA 1990)

Phosphorus

Phosphorus (P) deficiency is the most significant mineral deficiency in the cattle industry. About 70% of northern Australia has some degree of phosphorus deficiency.

Sheep have a lower requirement for phosphorus and deficiency is not commonly seen. They efficiently utilise phosphorus because they recycle a large proportion of phosphorus via salivary secretions.

A number of factors influence the levels of phosphorus available to the animal including:

- soil type and soil pH
- pasture growth stage
- intake of protein and energy.

Indicators of phosphorus status (ppm)

	'Acute'	'Deficient'	'Marginal'	'Adequate'
Soil phosphorus	<2	3–5	6–8	>10

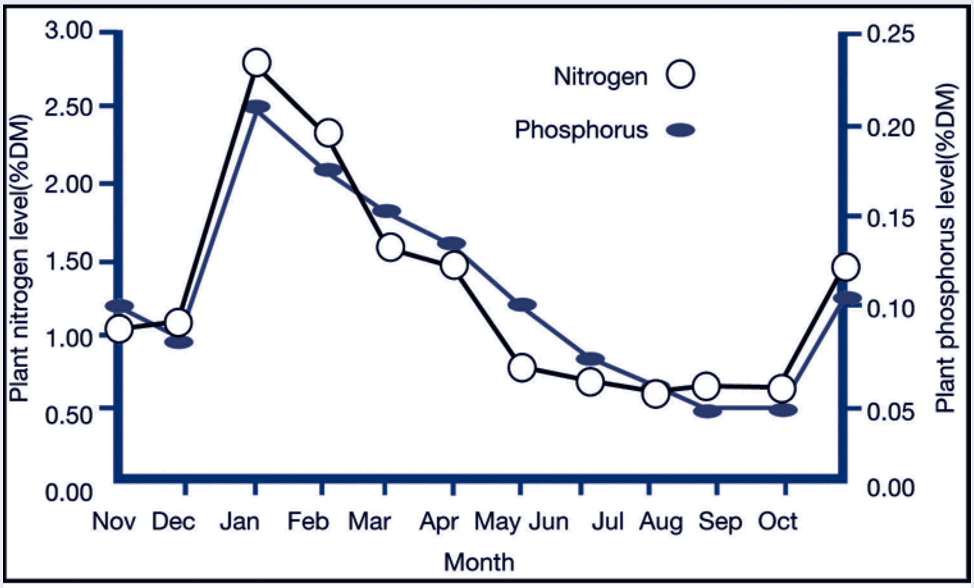
Symptoms of phosphorus deficiency in cattle include:

- poor growth
- poor fertility
- bone chewing (mortality from botulism often follows bone chewing if cattle are not vaccinated against this disease)

- soft and weak bones
- in extreme cases lameness as 'peg-leg' (osteomalacia).

During the dry season, nitrogen (N) is more likely to be limiting than phosphorus for the nutrition of the animal. Animals will show little if any response to phosphorus supplements fed at this time.

Concentrations of phosphorus and nitrogen in mitchell grass



Source: Burrows et al. (1988)

Some common acceptable sources of phosphorus to use as supplements

Name	Chemical composition		Comment
	P	Ca	
Monocalcium phosphate (MCP)	21–22	17–18	80% of P is water soluble
Dicalcium phosphate (DCP)	16–21	21–23	Low palatability
Tricalcium phosphate (TCP)	15–16	31	
Kynofos 21	21	18	Mix of MCP and DCP
Biofos	20.9	18	Mix of MCP and DCP
MAP (technical grade)	25–26	0	99% soluble 12%N
Phosphoric acid (food grade)	46%W/V	0	Highly corrosive

There are many commercial preparations that can be used as phosphorus supplements, most are based on the products listed above.

Unacceptable levels of Cadmium and Fluorine make many other products unsuitable to feed to livestock.

Table 2: Supplementary phosphorus needs (g/P/head/day) without bone demineralisation

		'Acute'			Phosphorus status 'Deficient'				'Marginal'			
Liveweight (kg)	Diet quality	Rate of gain (g/head/day)										
		250	500	750	250	500	750	1,000	250	500	750	1,000
Steers and dry heifers												
200	Average	4	7	11	2	5	9	na	1	4	8	na
200	Good	2	5	8	0	3	6	10	0	2	5	8
300	Average	3	7	11	1	5	8	na	0	3	6	na
300	Good	1	4	7	0	2	5	8	0	0	2	6
400	Average	3	7	10	0	4	7	n	0	1	5	na
400	Good	0	3	7	0	0	3	6	0	0	0	3
500	Average	3	6	10	0	3	7	na	0	0	3	na
500	Good	0	2	6	0	0	1	5	0	0	0	1
600	Average	3	6	10	0	2	6	na	0	0	2	na
600	Good	0	1	5	0	0	0	3	0	0	0	0

Nil liveweight gain assumed for breeders

Breeders		Third term of preg	3L milk /day	6L milk /day	Third term of preg	3L milk /day	6L milk/ day	Third term of preg	3L milk /day	6L milk /day
300	Average	4	4	8	2	2	5	0	0	3
300	Good	2	2	6	0	0	3	0	0	1
400	Average	4	4	7	1	1	4	0	0	2
400	Good	1	1	5		0	0	0	0	0
500	Average	4	3	7	0	0	3	0	0	0

na = not applicable as it is an impossible combination
Average' and 'good' represent diets with 'approximately 50% and 63% dry matter digestibility.
Note: The rates used in this table allow full bone mineralisation. However, research has shown that levels of 80% of the supplementary need could be fed for up to 3 months without effect on blood P or liveweight gain, but there could be significant bone demineralisation (i.e. P drawn from the bone).

Assumptions:
Feed intake (unsupplemented)
= 2.5 to 2.8% of body weight on 'good-quality' feed
= 2.00 to 2.3% of body weight on 'average' feed
'Acute' = 2 to 4ppm PB and 0.08% dietary P intake
'Deficient' = 5 to 6ppm PB and 0.11% dietary P intake

'Marginal' = 7 to 8ppm PB and 0.13% dietary P intake
Lactation requirement = 1.2g dietary P/additional litre of milk
Third term of pregnancy = 4g P/head/day additional

Source: McCosker and Winks (1994)

Conclusions

- Minerals are essential components of the diet but adequate amounts are usually provided by pasture.
- In northern Australia the most common mineral deficiency is phosphorus.
- Animal responses to mineral supplements are usually greater during the wet season than during the dry season, because the requirement for most minerals is higher when the animal is producing, i.e. growing or lactating.
- Since mineral supplements increase pasture intake, alleviating mineral deficiencies often needs to be combined with a reduction in stocking rate.

Other nutritional issues

Supplementation

There is a range of options for managing nutritional deficiencies.

For much of northern Australia, supplementation is a practical option to address nutritional deficiencies and ensure animals reach production targets.

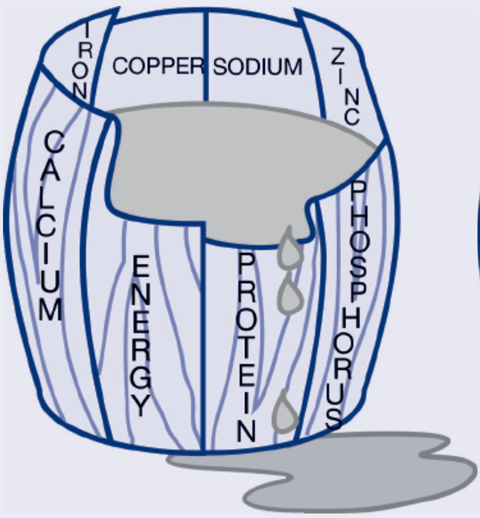
For the purposes of this discussion, a supplement is anything that is fed to cattle in the paddock, i.e. anything other than full feeding such as a feedlot.

The following sections provide key information that may influence animal performance. This should be kept in mind when undertaking supplementation programs.

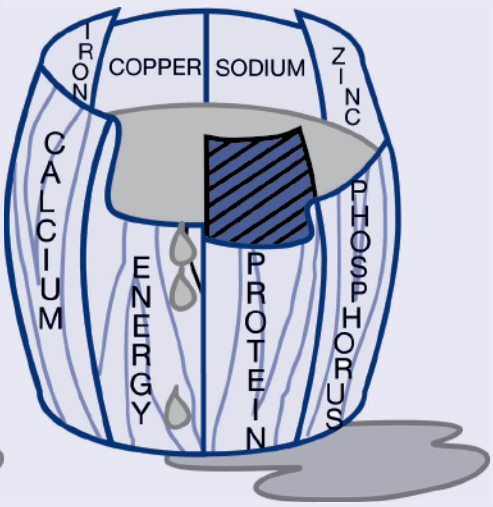
Primary limiting nutrient

Targeting the primary limiting nutrient is the priority for a cost effective supplementation program.

The primary limiting nutrient is protein.



Having fixed the protein deficiency the primary limiting nutrient is now energy.



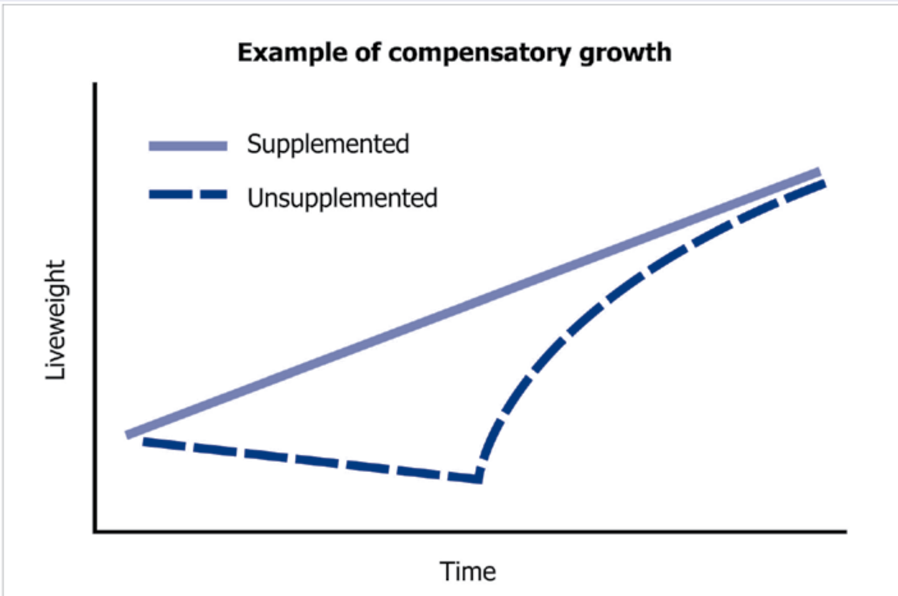
Compensatory growth

Compensatory growth is the better than expected growth performance seen in animals following a period of very low weight gain or weight loss. The extent of compensatory growth is influenced by the age of the animal, the severity and length of the restriction. Generally the move severely stressed or restricted the animal is, and the higher the quality of feed following restriction, the greater the compensation will be.

Compensatory growth works through a combination of reduced maintenance requirements, increased efficiency of growth, increased protein deposition and increased feed intake.

There are no hard and fast rules to predict compensatory growth. Just be aware that it exists and, if it occurs, it is a bonus.

It may negate the benefits of supplementation or provide a bonus weight gain.



Do all animals need to be fed?

Consider weight range across the group. Group animals as follows:

- will achieve target without help
- need help to achieve target
- will not get there.

Rumen modifiers

'Rumen modifiers' includes anything that modifies the rumen environment or the population of microorganisms in the rumen. In their normal definition, rumen modifiers are substances that modify the composition of the microorganisms in such a way as to be beneficial to some species but inhibitory to others. This obviously has an effect on the functioning of the rumen.

Rumen modifiers work by one or more of the following ways:

- change rumen environment or microorganism population
- increase production of propionic acid and decrease methane
- change protein metabolism so that more protein is available to animal.

Rumen modifiers improve feed conversion efficiency. Therefore, at the same level of feed intake, animal production will be improved.

Some of the common rumen modifiers change the rumen microbial population. In such a way that the end products of rumen fermentation are changed, for instance the amount of propionate is increased in relation to other VFAs. A consequence of the increase in propionate production is a reduction in methane production thus increasing the amount of energy available to the animal.

Another benefit of using some rumen modifiers is that protein metabolism is changed, resulting in increased protein availability to the animal. Rumen modifiers like Rumensin® and Bovatec® usually only work when animals are gaining at a reasonable rate, for instance 0.5 kg/day. At low growth rates or maintenance/loss, there is no advantage in using a rumen modifier.

Rumen modifiers are also commonly used to control coccidiosis in young weaners and also for bloat control.

Some rumen modifiers are unpalatable, and when mixed with a supplement, can reduce the intake of a supplement. This can be used in a practical sense to help regulate supplement intake.

Rumen modifiers such as Monensin are toxic to horses. They must be added at low rates of inclusion; following mixing instructions very carefully.

Hormonal growth promotants (HGPs)

There are two broad types of hormones used as growth promotants: oestrogens (female hormones) and androgens (male hormones).

Oestrogen based HGPs, e.g. oestrodiol, stimulate the release of the animal's own growth hormones. This increases cell growth and protein retention.

Androgen based HGPs, e.g. testosterone and trembolone acetate, reduce the breakdown of muscle cells and stimulate lean meat production.

Animals need to be on a good plane of nutrition to obtain optimum benefit from HGPs. The use of HGPs is controversial. Animals treated with HGPs are banned from some markets. All animals treated with HGPs must have some form of permanent identification.

Example of a break-even analysis

Option 1: To sell 330 kg liveweight (estimated dressing percentage = 47% cull cows now, at the going market price of $2.30/kg carcase weight

Option 2: To increase carcase weight to over 200 kg with a grain supplement costing $210/tonne

Assumptions		
Expected daily liveweight gain on pasture and grain		= 0.95 kg
Expected number of days on pasture and grain		= 85 days
Expected mean daily grain consumption		= 9 kg
Expected final dressing percentage		= 51%
Annual interest rate		= 10%
Present per head value of the cull cows		
Carcase weight estimated to be	*330 kg x 0.47*	= 155.1 kg
Present value	*$2.30 x 155.1 kg*	**= $356.73**
Expected per head costs to supplement cull cows		
Grain	*9 kg x 85d x $210/tonne ÷1000*	= $160.65
Veterinary costs		= $1.00
Interest/head @ 10%	*$248.16 x (0.10 ÷ 365d) x 85d*	= $5.78
Interest on feed for 50 days	*(160.65 x 10%) x 50/365*	= $2.20
Total costs:		**= $169.63**
Total cost per head - initial value of cow + total costs		**= $526.36**
Estimated total liveweight gain	*0.95 kg/d x 85 days*	= 80.75 kg
Estimated final liveweight	*330 kg + 80.75 kg*	= 410.75 kg
Estimated carcase weight (dressing percent)	*410.75 kg x 0.51*	= 209.5 kg
Break-even selling price	= Total cost ÷ Expected final weight = $526.36 ÷ 209.5 kg **= $2.51/kg carcase weight**	

This is the price that must be received to equal the return from Option 1. Is the price, or better, achievable for this class of animal? If not, then Option 1 is financially the better option. But, how confident are you of reaching this target? What margin of safety would you add to the break-even price?

Answers to Quick Quiz

1) d, 2) b, 3) c, 4) d, 5) c, 6) c

If you scored 6 - Congratulations – Your neighbours should listen carefully to your advice.

If you scored 4 - 5 Well done – but there could be areas where you need to improve your knowledge.

If you scored <4 – Congratulations - you have at least had a go and are willing to learn more.

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